

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

DESCRIPTIONS OF THE SPECIES OF CYCADEOIDEA,
OR FOSSIL CYCADEAN TRUNKS, THUS FAR DIS-
COVERED IN THE IRON ORE BELT, POTOMAC FOR-
MATION, OF MARYLAND.*

BY LESTER F. WARD.

On November 4, 1893, I read a paper before this Society on 'Cycadean Trunks in the American Cretaceous,' which under the fuller title, 'Fossil Cycadean Trunks of North America, with a Revision of the Genus Cycadeoidea Buckland,' was published in the ninth volume of its Proceedings.† At that date only one species of cycadean trunks had been published from the Iron Ore beds of Maryland. This was founded on four specimens that had long lain in the Museum of the Maryland Academy of Sciences at Baltimore. They had been collected by Philip Tyson before the civil war, and he had mentioned them in his report as State Agricultural Chemist in 1860, recognizing their cycadean character and applying to them the term "Cycas," apparently without intending thereby to refer them to the living genus by that name, but merely to denote their resemblance to the trunks of plants familiar to all under that name. Much interest, I learn, was excited at the time by the discovery of these specimens, and the Maryland Academy of Sciences is said to have discussed their nature at a number of its meetings. Indeed, I have been

* Read before the Society February 27, 1897. Published by permission of the Director of the U. S. National Museum.

† Proc. Biol. Soc. Washington, vol. IX, Washington, 1894, pp. 75-88.

told that the subject came at last to monopolize its proceedings and that considerable asperity was ultimately created in the discussions, so much so that all at length became tired of the subject and it was allowed to drop completely out of their deliberations, never to be revived. At all events, it was nearly twenty-five years before any one's attention was again prominently called to these objects.

Mr. Tyson, however, had taken the trouble during the time that the question was uppermost to have photographs made of one of these specimens. He had also found much silicified wood in the Iron Ore beds, and he caused some large blocks of this to appear in the same view with the cycad trunk. Prints of this view were sent to many of the prominent paleontologists of this country and Europe. Among those receiving them was Dr. J. S. Newberry, and since his death his copy has been found at the Geological Museum of Columbia University and kindly placed in my hands by Dr. Arthur Hollick. In 1885 Mr. W. J. McGee, having learned that these specimens were still in the Museum of the Maryland Academy of Sciences, was permitted, through the kindness of the president of the Academy, Professor P. R. Uhler, to have a series of photographs taken of the two principal trunks. Copies of these photographs are also in my hands, and they were shortly after reproduced and published, forming plates clxxiv to clxxx of Professor Fontaine's *Potomac or Younger Mesozoic Flora*.* As stated in my former paper, Professor Fontaine described these trunks under the name *Tysonia Marylandica*, but as they do not belong to a genus distinct from those of Europe, Capellini and Solms-Laubach restored them to Buckland's genus *Cycadeoidea*. The specimens are now in the Geological Museum of Johns Hopkins University.

Soon after the appearance of Professor Fontaine's work in 1890, Professor Uhler succeeded in obtaining a few additional fragments, but interest in the subject was not fairly aroused until about the year 1893, when Mr. Arthur Bibbins of the Woman's College of Baltimore began his remarkable series of discoveries which has resulted in bringing to light no less than fifty-nine specimens of these interesting objects. An account of his researches and results was published by me in 1894,† at which time

* Monographs of the U. S. Geol. Survey, vol. XV, Atlas.

† Recent Discoveries of Cycadean Trunks in the Potomac Formation of Maryland. Bull. Torr. Bot. Club, vol. XXI, No. 7, July 20, 1894, pp. 291-299.

he had already added thirty-five specimens to all that had been hitherto reported. Since that date he has continued actively to prosecute this work and has secured many more. Too great praise cannot be bestowed, either upon him for his successful method of work and his untiring zeal and industry, nor upon the Woman's College and its able president, Dr. John F. Goucher, for the liberal spirit shown, the keen scientific interest manifested, and the substantial aid rendered in advancing this work.

I also stated in the paper last referred to that through the generosity of President Goucher and all connected with that institution this entire collection had been loaned to the United States National Museum, and turned over to the Department of Fossil Plants for systematic elaboration, and the additional specimens, as fast as they were discovered, have also been regularly sent to Washington to join the rest. I had already commenced work on the important material of the same general nature from the Black Hills, an account of which was given in the paper presented to this Society of which I have spoken. It was decided to embody all the material in the Museum and all that could be secured from any American deposits in one general monograph of the Fossil Cycadean Trunks of North America, Dr. F. H. Knowlton to assume charge of all that pertained to the microscopic study of the internal structure and I to deal with the external and macroscopic aspects. I had hoped to have completed my part of the work before this, but many causes conspired to retard progress. Other pressing duties, both in the field and in the office, reduced the amount of time that it was possible to devote to it. The necessity for seeing the European specimens practically obliged me to spend a season on the other side of the Atlantic, the results of which had to be worked up and published.* The amount of labor involved was also very great, and the progress made is as satisfactory as could be expected under the circumstances. Much has been done on all classes of the material, but latterly I have been devoting myself chiefly to the Maryland specimens. It has been necessary to study anew all those obtained by Tyson, now in the Geological Museum of Johns Hopkins University, ample facilities for which have been generously extended to me by Professor W. B. Clark. Professor Uhler has also kindly allowed me to describe those in the Museum of the Maryland Academy of Sciences, and he sent

* See the Sixteenth Annual Report of the U. S. Geological Survey, pp. 463-542.

the two principal ones to Washington for the purpose. Artistic photographs have been taken of these and of all the more important trunks in Mr. Bibbins' collection.

A year ago I had proceeded far enough to have discovered that the cycadean trunks from the Iron Ore beds of Maryland embraced no less than seven good species which could be clearly separated and described, and since that time I have accomplished the work of describing and naming these species and of assigning each specimen to its appropriate specific group. As it is very convenient in the general discussion to be able to speak of these forms in a definite way, I have decided to publish these names with the descriptions, so that the new species may not need to be mentioned prior to such description, thereby cumbering the literature with *nomina nuda*. It is, however, clearly to be understood that these descriptions are not final, as they are based entirely on external characters and such macroscopic observations as I have been able to make of the internal parts prior, for the most part, to the cutting of sections, and do not embody any results that may be arrived at by Dr. Knowlton after a microscopic study of the various tissues. This latter, however, can scarcely result in reducing the number of species, as the more general characters are those that have been chiefly relied upon for specific differentiation, and if it results in increasing the number by showing that some of the specimens possess internal characters that cannot be specifically united with the others, this will lead to no confusion.

With regard to the classification adopted, I may remark that Buckland, in studying for the first time the fossil trunks from the Purbeck beds of the Portland quarries, called to his assistance the great contemporary botanist, Robert Brown, whom he expressly credits with the suggestion that the differences between the fossil and living forms are sufficient to establish a new family distinct from the existing family of Cycadeæ, and to which the name *Cycadeoideæ* was given. The generic name *Cycadeoidea* was also employed at the same time, but it afterwards transpired that this was not approved by Robert Brown, who only proposed the family name. Brown must therefore be credited with the name *Cycadeoideæ* and Buckland with *Cycadeoidea*. The wisdom of Brown's suggestion has been abundantly vindicated by the subsequent study of these forms, and the more their internal anatomy is made known, especially the nature of their inflorescence and

fructification, the clearer it becomes that all fossil cycadean vegetation from beds below the Tertiary represented a group distinct from the recent Cycadaceæ. When the nature of the reproductive apparatus was made known by Carruthers in the remarkable specimen which came from Luccomb Chine, on the Isle of Wight, he proposed for it a new generic name *Bennettites*, and Count Solms-Laubach established on the same data the family name *Bennettitææ*. But it soon became obvious that the restricting of this name to this one form was simply based on our ignorance of the reproductive apparatus of other trunks, and wherever further data as to the latter have been brought forward they have strengthened the presumption that most or all fossil forms possessed a similar reproductive apparatus. Count Solms has therefore, in his latest important paper on the Bennettitææ of the Italian museums, referred them all to Buckland's genus *Cycadeoidea*. In this, too, he incidentally includes many other European and some American forms, while adhering to the one species of *Bennettites*, *B. Gibsonianus*, in which the fruit is known, and as a result of an examination of photographs of our American forms he has stated in letters to me that certain of them are certainly to be referred to *Bennettites*. But in such studies as I have been able to make of these forms, whether from Maryland or from the Rocky Mountain region, I am unable to see anything that can be called a generic difference, and they all resemble the Italian forms more closely than they do those from Portland. I therefore, in the former paper, grouped them all as *Cycadeoidea*, and I have not since seen any reason for departing from this view. Until their internal structure is further studied I shall adhere to this name, and in view of all that has been said I am disposed to extend Robert Brown's group name to all the Mesozoic cycadean vegetation, whether represented by trunks or by foliage, fruit, or other organs, on the general assumption that however many genera there may have been, if they could be correlated the foliage, etc., would belong to the trunks found in the same general beds. In a matter of which so little is known, all is at best provisional, and a convenient and flexible nomenclature is the chief result to be aimed at.

The full classification of the Cycadaceæ would therefore be to use that term to represent the entire family, both living and fossil, and to subdivide it into the two subfamilies, the Cycadææ for the living forms and the Cycadeoideæ for the fossil forms. This is the classification adopted below.

Subkingdom SPERMATOPHYTA.

Class GYMNOSPERMÆ.

Family CYCADACEÆ Lindley.

Subfamily CYCADEOIDEÆ Robert Brown.

Fossil cycadean vegetation of Mesozoic age represented by trunks, foliage, and fruits, and embracing a large number of genera and species, the trunks usually not accompanied by other organs than the bases of the leaf stalks, and reproductive axes included in a false bark or "armor" generally of considerable thickness; foliage usually also found separate from other parts, and fruits and rarely flowers similarly isolated. The number of genera and species is therefore necessarily duplicated and multiplied, owing to the impossibility of correlating the detached parts, but that those found at similar horizons and localities belonged together admits of no doubt. The trunks differ in size and form much as do living Cycadaceæ (Cycadææ), and characters of all parts show resemblances to existing genera. It is, however, probably incorrect to say that the latter have descended from the former, or that the fossil forms are embryonic types of the living forms, and the correct conception of the subfamily is embodied in the law of sympodial development,* according to which the principal trunk line of descent which the fossil forms represent, and which attained its maximum development in Mesozoic time, became extinct, while inferior lines or branches represented by living forms persisted into modern times. This accounts for the fact so prominently insisted upon by Count Solms-Laubach and others that the fossil forms, at least those in which the reproductive organs are preserved embedded in the armor of the trunks (Bennettites), are structurally more advanced than the living Cycadaceæ, a fact which finds its counterpart in the Lepidophyta and Calamariæ of the Carboniferous and in the Dinosauria of the Mesozoic.

Genus *Cycadeoidea* Buckland.

1827. *Cycadeoidea* Buckland, Proc. Geol. Soc. London, vol. I, No. 8, pp. 80-81 (session of June 6, 1827).
 1828. *Cycadeoidea* Buckland, Trans. Geol. Soc. London, 2d ser., vol. II, pp. 375-401, pl. xlvi-xlix.

Fossil trunks of *Cycadeoidea*, chiefly low (30-90 centimeters in height) and more or less conical or oval in shape (15-75 centimeters in diameter),

* Proc. Biol. Soc. Washington, vol. V, Washington, 1890, p. 24. Lester F. Ward: The Course of Biologic Evolution (reprint of above), p. 2.

usually simple, but sometimes branching, with a depression at the summit, in the middle of which, when not decayed, there is a terminal bud of conical shape; terminal bud, however, usually wanting in the fossils, leaving a cavity commonly known as the "crow's nest," by which name for this reason the specimens from the Portland quarries are popularly known. The armor consists of appendicular and reproductive organs surrounding and enveloping the axis, the former being the bases of the leaf stalks or petioles, which are surrounded by a dense mat of ramentum or fine hairs.

The leaf stalks are normally four-sided and four-angled, the lateral angles acute and nearly equal, the vertical angles obtuse but unequal, the lower much sharper than the upper, so as to render the cross section sub-rhombic. This form varies on the one hand to a true rhomb, and on the other hand to a true triangle, the most frequent intermediate type being that in which the upper angle is wanting, and the two upper sides are reduced to a simple curve or arch, so that the cross section assumes the form of a drawn bow and bowstring, the arch formed by the two upper sides representing the bow and the two lower sides, with their reëntrant angle, representing the bowstring. In size the leaf stalks vary from 15 to 35 millimeters in width measured between the lateral angles, and from 5 to 20 millimeters in height measured between the vertical angles, or from the lower angle to the summit of the arch formed by the two upper sides. The line joining the former is not generally horizontal or at right angles with the axis of the trunk, but one is usually slightly lower than the other. The line joining the latter is not generally vertical or parallel to the axis of the trunk, but one is usually a little on one side of the other. The only portion of the leaf bases that is always preserved in the fossil state is the mat of ramentaceous hairs that surrounds them. In the great majority of cases the petioles themselves are decayed to a greater or less distance below the summit of these mats, which thus constitute walls surrounding and enclosing the portion that remains of the petioles, if any, and in their absence forming definite cavities having the shape of the cross section of the leaf stalks, which constitute the leaf scars. These leaf scars, with or without the lower portion of the leaf bases, penetrate to the axis of the trunk and form a varying angle with it. Normally this angle is a right angle over all the central portions of the trunk, while below the organs are slightly descending and above more and more ascending to the apex, where they become vertical. At the summit, too, they diminish in size and usually in form, and are reduced in and immediately around the terminal bud to small triangular or polygonal bracts (*perulæ* of Miquel). In some species (*C. Uhleri*) all the organs of the body of the trunk are deflexed, and in one (*C. Goucheriana*) there is a definite zone near the middle of the trunk, below which they are descending and above which they are ascending. The leaf scars are arranged in a more or less exact quincunx order, and usually in two sets of spiral rows around the trunk, in one of which they ascend from the base in the direction from left to right and in the other from right to left, crossing each other at varying angles, and both rows making a certain angle with the axis of

the trunk, which varies with the species and more or less with different specimens of the same species. One of the two sets of rows is usually more distinct than the other, but the more distinct rows sometimes pass upward from left to right and sometimes from right to left. The bases of the petioles when present and well preserved often show at the surface presented to view a row of pits all round parallel to the walls and at different distances from the margin representing the vascular strands. Other such pits are sometimes present near the center. The petioles are frequently disarticulated at a natural joint, which may fall near or at the summit of the scar, or it may fall some distance within the scar. In some species there are two such joints separated by a node. Occasionally these joints consist of a thin membranous diaphragm stretching across the petiole, of firmer texture than the rest of its substance. Even where the petioles are wholly absent the position of the joints or diaphragms can sometimes be determined by a sharp ridge round the inside of the scar. The walls are made up of the ramentum of two adjacent petioles. In some cases these matted masses are so dense as to produce a simple homogeneous plate on all four of the sides, which, where the petioles are wanting, forms a deep, angled cavity of exactly the shape of a cross section of the petiole. Usually the portion of the wall furnished by each of the adjacent petioles can be distinguished by a junction line or commissure, visible along the outer edge of the wall. This commissure sometimes takes the form of an intermediate plate of a less dense consistency than the two outer plates. In other cases this central plate is much thicker than the two outer ones, which latter may be reduced to the appearance of thin linings of the scars. In still other cases the central portion is more or less open and cavitous. The walls vary from 1 millimeter or even less to 5 millimeters or, in rare cases, 8 millimeters in thickness.

The other class of organs that help to make up the armor are the reproductive organs. These are borne on all parts of the surface of the trunks except, perhaps, in immediate connection with the terminal bud, which is exclusively an organ of growth. They are scattered about with very little order over the surface among the leaf scars. They are usually of a harder substance than that of the foliar organs and better adapted to resist erosive influences to which the fossil trunks are exposed. Where the trunks are worn, therefore, the reproductive axes are liable to protrude somewhat. Viewed from without, they usually present an organ with an elliptical cross section, the longer diameter being nearly horizontal, variable in size, but always larger than the leaf scars. The central portion is often wanting, and a funnel-shaped cavity less deep than the leaf scars takes its place. When the central portions are present they show markings having the form which the outer ends of the essential organs present, which is very variable and usually obscure. Surrounding the central portions are several rows of open scars arranged concentrically. These scars are sometimes triangular, quadrangular, polygonal, or nearly circular; but the most of them, especially the outer ones, are somewhat crescent-shaped, having the concave side toward the center. The inflorescence is a spadix surrounded by an involucre consisting of the concen-

trically arranged bracts or scales whose scars were last described. The spadix has a receptacle at the base, located near the inner surface of the armor and supplied with fibers from the axis. From the receptacle there rise two kinds of organs, first, peduncles or filaments, known in a few specimens to bear seeds and conjectured in one specimen to bear anthers at their summits, and, second, elongated chaff-like scales more numerous than the latter and rising above them, the upper portions expanding and forming a dense mat or covering over the essential parts. In most cases all these organs are wholly included in the armor, the only seeds that have thus far been found being deeply embedded in the tissues. The organs of inflorescence are probably axillary, but owing to the proximity of the leaf scars this is not generally apparent. In regions of the surface where they occur they usually crowd the leaf scars and cause variations in their shape. This effect is most marked on the upper sides of the scars, often quite obscuring or obliterating their normal features.

The axis of the trunk inclosed in the armor when complete consists of four parts, which, enumerated from without inward, may be denominated respectively as (1) the libro-cambium, (2) the parenchymatous wood, sometimes called the cortical parenchyma, (3) the wood proper or fibrovascular zone, and (4) the medulla or pith. In many cases the libro-cambium zone cannot be definitely distinguished from the cortical parenchyma, and nothing is visible but the large and numerous vascular bundles passing out from the interior into the leaves; but sometimes there occurs a definite line or thin zone of loose tissue immediately below the bases of the leaf stalks. There is usually a zone of apparently homogeneous cellular tissue, often of considerable thickness, filling the interval between the armor and the woody axis. The woody zone consists of one or more rings of exogenous tissue traversed by medullary rays. Where more than one, they are separated by thin interstices of parenchymatous tissue. The medulla is usually large and composed of coarse parenchyma.

Cycadeoidea Marylandica (Font.) Cap. and Solms.

1860. *Cycas* sp. Tyson, First Report State Agric. Chem. Maryland, p. 42.
 1870. *Bennettites* sp. Carruthers, Trans. Linn. Soc. London, vol. XXVI, p. 708.
 1879. *Cycadeoidea* sp. Fontaine, Am. Journ. Sci., 3d ser., vol. XVII, p. 157.
 1889. *Tysonia Marylandica* Fontaine, Potomac or Younger Mesozoic Flora, Monogr. U. S. Geol. Survey, vol. XV, p. 193, pl. clxxiv-clxxx.
 1892. *Cycadeoidea Marylandica* (Font.) Cap. and Solms, Mem. Real. Accad. Sci. Ist Bologna, ser. V, tom. II, pp. 179, 180, 186.

Trunks of medium or rather large size, almost always more or less laterally compressed so as to be elliptical in cross section, conical in shape or slightly narrowed near the base with a terminal bud set in a slight depression at the summit, simple, or in one specimen, apparently having one branch; mineral constitution very variable according to mode of preservation, but usually not hard, flinty, or heavy and compact; reddish, pinkish, drab, or ash colored; 25 to 45 centimeters high, 24 to 40 centi-

meters in longer and 12 to 26 centimeters in shorter diameter, with a girth of from 70 centimeters to one meter; organs constituting the armor proceeding at a right angle to the axis except above, where they are ascending, and near the base, where they are sometimes slightly descending; leaf scars arranged in two series of spiral rows crossing each other usually at a different angle to the axis of the trunk, the angle varying from 30° to 75° ; scars usually subrhombic, *i. e.*, with the lateral angles nearly equal and the vertical ones unequal, the lower more acute than the upper, the latter often reduced to a mere groove or wanting entirely and the two upper sides together forming an arch, the whole scar simulating a drawn bow and bowstring, but sometimes triangular, the upper sides joined along a horizontal line, or more irregular in shape, occasionally with four curved sides and four acute angles; the width as represented by a line joining the two lateral angles varying from 15 to 25 millimeters, and the height as represented by a line joining the two vertical angles (which would rarely be parallel to the axis of the trunk) varying from 6 to 15 millimeters; remains of the petioles usually present in the scars at different distances from the summit, often bearing evidence of having been disarticulated at a natural joint, sometimes indicating the existence of two such joints at different depths in the scars, and showing that these joints consist of a diaphragm across the petiole which may remain after the substance of the petiole has partly decayed below it leaving a hollow space, portions of the outermost diaphragms also sometimes adhering to the sides of the scars in the form of a ridge surrounding them; vascular bundles rarely visible under an ordinary lens, but occasionally seen in the form of a row near the outer margin all round the leaf base with a few near the center; ramentum walls usually rather thick, but varying from less than 1 millimeter to 9 millimeters, ordinarily with a more or less distinct line marking the junction of the parts belonging to adjacent petioles (commisure), sometimes with a distinct plate or layer of less compact tissue between these, occasionally but rarely affected with pits or small bract scars especially in the angles; reproductive organs usually abundant, often solid and protruding, generally more or less distinctly marked in the center by the remains of the essential organs and surrounded by bract scars in several concentric rows, but often decayed in various degrees, leaving corresponding funnel-shaped cavities, commonly elliptical in cross-section, wider than high, very variable in size, the major axis 15 to 40 millimeters and the minor 10 to 30 millimeters; armor thin, 2 to 5 centimeters, usually joined to the internal parts by a clear line, but without measurable thickness, but sometimes very irregularly so joined and occasionally showing a thin libro-cambium layer; woody zone 3 to 10 centimeters thick, usually with two or three more or less distinct rings, the outer or parenchymatous zone thicker and firmer than the inner or fibrovascular zone; medulla usually homogeneous in structure, elliptical, the major axis 8 to 17 centimeters, the minor 3 to 9 centimeters.

Eighteen specimens are referred to this species. The type specimens are of course the originals of Tyson, of which the one photographed by

him should stand at the head. I shall refer to it as No. 1 of the specimens at the Johns Hopkins University, although Professor Fontaine calls it No. 2. It is the largest and most perfect of the trunks belonging to this species. The other nearly perfect trunk of the original lot, which Professor Fontaine calls No. 1, will be referred to as "Johns Hopkins Cycads No. 2." The other two specimens described by Professor Fontaine were fragments, and were called by him "fragment No. 1" and "fragment No. 2." The first of these belongs to another species, as will be seen below. His "fragment No. 2" probably belongs to this species, but is somewhat anomalous. It will be referred to as "Johns Hopkins Cycads No. 3." A few years ago Professor Clark informed me that another specimen had been found about the University buildings, but he could give no further account of it. With his permission I have examined and described it and have had photographs made not only of this, but also of the other two fragments, which had not hitherto been illustrated. The newly found specimen, although not an entire trunk, is much more complete than either of the other fragments. It clearly belongs to this species, and will be referred to as "Johns Hopkins Cycads No. 5." The largest specimen in the Museum of the Maryland Academy of Sciences also belongs to this species, although it has suffered much from wear and many of the characters are obscured. It will be referred to as "Maryland Academy Cycads No. 1." The remaining thirteen specimens belong to the Woman's College and embrace the following numbers of the museum of that college: 1192, 1428, 1481, 1486, 1656, 1657, 3050, 3051, 3056, 3057, 3324, 3328, 3341. Many of these are fine specimens, consisting of nearly complete trunks, and of the specific identity of such there is no doubt, but there are several small and imperfect fragments, which scarcely show characters enough to render their specific assignment safe. In these and all similar cases I reserve the right to alter the assignment in case further study or future discovery shall seem to require it. The most important of these specimens is No. 1481, because, besides being a nearly perfect trunk, showing all the typical characters, it is the only one of Mr. Bibbins' specimens whose exact stratigraphical position is definitely determined.

***Cycadeoidea Tysoniana* n. sp.**

Trunk medium sized or large, more or less compressed laterally; leaves slightly ascending; leaf scars arranged in spiral rows, 9 millimeters high, 22 millimeters wide, subrhombic, empty to some depth, petioles persistent at base, the vascular bundles arranged in one row near the exterior and a group near the center, often persisting after the decay of the remaining substance; ramentum walls thin, often with a layer of spongy substance in the middle, wrinkled on the edges; reproductive organs few and small; armor 5 centimeters thick; libro-cambium zone sometimes distinct, 3 millimeters thick; woody zone 6 to 8 centimeters thick, consisting of a broad outer parenchymatous layer 4 to 6 centimeters thick, and a narrow inner vascular zone 1 centimeter thick, the latter usually between open

tissue without and within, its inner wall strongly marked with longitudinal grooves; medulla distinct and homogeneous, light and porous.

This species is represented only by a single specimen, No. 1472 of the Woman's College. It approaches *C. Marylandica* in some respects, but differs in the larger leaf scars, thinner walls, thicker armor, and the great paucity of reproductive organs. It is to be regretted that Professor Fontaine did not name the original species with which Mr. Tyson's name will always be so intimately connected in his honor instead of the genus, which must fall before the laws of nomenclature. I have endeavored in the above name to supply the defect in some small degree.

***Cycadeoidea McGeeana* n. sp.**

Trunks low and flat, with ample diameter, sometimes three times as thick as high, yellowish, brown, or nearly black, more or less porous and spongy, and of low specific gravity; leaves and spadices set nearly at right angles to the axis; leaf scars arranged somewhat definitely in quincunx order and disposed in spiral rows around the trunk, small and uniform in shape, subrhombic with the vertical angles obtuse, the lateral ones acute, narrow-elongate, 6 to 10 millimeters in vertical by 16 to 20 millimeters in lateral dimensions, averaging 8 by 20 millimeters, usually empty by the disappearance of the leaf bases, at least to a considerable depth; ramentum walls thin, often less than one millimeter, with or without evident commissure, and with occasional punctations; axes of inflorescence few and scattering, sometimes projecting and filled with the substance of the spadix, sometimes cavitous from the decay of the essential organs, surrounded by obtusely triangular or somewhat crescent-shaped bract scars; armor 4 to 5 centimeters thick; liber and cambium sometimes distinguishable; woody zone usually divided into two or three rings; medulla large, porous.

A very distinct species of low and squat trunks, some of them having almost the form of a car wheel, only a very small part of which can be due to vertical compression. The external organs, however, closely resemble those of *C. Tysoniana*. It embraces seven specimens, all belonging to the Woman's College, as follows: Nos. 1471, 1659 and 1659*a*, which belong together, 3055, 3068, 3323, 3325, and 3349. The most complete specimen is No. 1471, which is taken as the type and which has been cut through vertically and the surfaces polished. The specimen consisting of the two complementary fragments 1659 and 1659*a* is also very interesting, though representing only about two-thirds of the whole trunk. The other specimens are all fragments.

I have named the species for Mr. W J McGee, by whom the Potomac formation was named and whose extensive studies in that formation are well known. As stated above, it was largely through his efforts that interest in the cycads of the formation was revived, and he it was who caused the photographs to be taken that were used to illustrate Professor Fontaine's monograph of the flora.

***Cycadeoidea Fontaineana* n. sp.**

Trunks small and low, usually much compressed or flattened vertically, light brown to whitish in color, often spongy or porous and of low specific gravity; leaves and spadices set nearly at right angles to the axis; leaf scars not obviously arranged in spiral rows or imperfectly so arranged, variable and irregular in shape, usually with four angles and four curved sides, often in the form of a cross, rarely subrhombic, small, 8 to 12 millimeters in vertical and 14 to 25 millimeters in lateral measurement, averaging 10 by 19 millimeters; ramentum walls thick, 4 to 10 millimeters, usually without commissure or punctations; leaf bases rarely present, when so, spongy or porous without visible bundles; terminal bud (present in one specimen) 6 centimeters high, 65 millimeters broad at the downwardly convex base, definitely bounded below, symmetrically conical above, consisting of a mass of densely matted bracts imbricated along a central axis; reproductive organs few and imperfectly defined, usually cavitous in the center and sometimes surrounded by irregular-shaped bract scars; armor rather thin, 2 to 4 centimeters; liber and cambium obscure; woody axis divided into several rings, sometimes consisting of a loose, open structure separated by thin, firm plates, the inner face next the medulla definitely marked by the remains of vessels and medullary rays; medulla large, marked on the external surface by thin longitudinal ridges or lamellæ varying from 1 to 3 centimeters in length, the ends overlapping adjacent ones (*Cycadeomyelon* Saporta), internal parts coarse and porous or somewhat chambered.

This species resembles *C. McGeeana* in the general form of the trunks, but the external organs are very different. It embraces fifteen specimens, all but two of which belong to Mr. Bibbins' collection. The two smaller specimens in Museum of the Maryland Academy of Sciences have been somewhat doubtfully referred to this species. They are fragments, and show so few characters that their specific relations are obscure. The other specimens bear the following numbers of the Museum of the Woman's College of Baltimore: 1467, 1470, 1473, 1485, 1488, 1658, 3046, 3122, 3326, 3327, 3346, 3347, 3350. No. 1467 has been taken as the type of the species, although it does not show quite all the characters. It has the most perfect terminal bud in the entire collection, and a vertical section of the specimen has been made which passes through the center of the bud. There are two other specimens of special interest; one of these is No. 1470, which consists of a fine piece of the medulla, with its characteristic external markings (*Cycadeomyelon* of Saporta), to which is attached a portion of the armor and connecting tissues in such a manner as to show their relations. The other is No. 3046, called the "chicken trough" because so used by its owner at the time of its discovery. The large decayed cavity at the summit affords an excellent view of the structure of the internal parts. The remaining specimens are fragments of greater or less completeness.

In naming this species I have wished to commemorate the pioneer investigator of the deposits from which the cycads are derived and to whom

science is indebted for the greater part of all that is known of the flora of these deposits.

Cycadeoidea Goucheriana n. sp.

Trunk large, cylindrico-conical with elliptical cross section, 30 to 50 centimeters high, 25 to 50 centimeters in diameter, light colored and of low specific gravity, somewhat chalky and friable; lower leaves somewhat deflexed, upper ones ascending, the line between the two definite and encircling the trunk near the middle; leaf scars arranged in two sets of spiral rows, both having nearly the same angle to the axis, 45° or greater; scars variable in size and shape, chiefly subrhombic to nearly triangular with curved or fluted sides, inner wall of the tubes marked by a raised line around it; scars averaging 11 millimeters in vertical and 23 millimeters in lateral measurement; leaf bases usually absent or only adhering to the bottom of the scars; ramentum walls thick, more or less divided into irregular laminae or scales with fissures between them, their outer edges ragged; reproductive organs numerous, well marked, irregularly scattered over the surface, most abundant at the narrower sides, usually cavitous in the center, sometimes solid and protruding, surrounded by concentrically arranged crescent-shaped bract scars, sometimes well exposed and clearly distinguishable into spadix and involucre, the scales of the latter imbricated, the entire organ conical with the apex toward the axis of the trunk: armor 3 to 5 centimeters thick, separated from the wood by a definite line; woody zone 4 centimeters thick, consisting of an outer parenchymatous ring 3 centimeters thick, a thin ring of loose open structure, and two thin plates separated by another ring of coarse cells divided by radial partitions, the inner walls of both plates marked with the scars of the medullary rays, the pattern different in the two cases, the scars on the inner plate 13 millimeters long, those on the outer longer and tapering upward; medulla large, elliptical, tapering upward, of a coarse, homogeneous structure.

Only one specimen referable to this species has thus far been brought to light, but this is one of the most perfect and also one of the most beautiful of all that have been discovered in the Iron Ore beds. It is further of special interest from the circumstance that its exact stratigraphical and local position when found is so thoroughly vouched for that there is little room for doubt in the matter. It is with great pleasure that I name it in honor of Dr. John F. Goucher, president of the Woman's College of Baltimore, to whose liberal and munificent policy the entire collection is due.

Cycadeoidea Uhleri n. sp.

Trunks small, 28 centimeters high, 20 centimeters in diameter, 50 to 60 centimeters in girth at the thickest part, circular, or only slightly elliptical in cross section, conical or somewhat cylindrical-conical in shape, contracted at the base, silicified, but porous and light, reddish or gray in color; leaf scars definitely arranged in quincunx order and spiral rows

around the trunk, one of these sets of rows ascending at an angle of 45° to the axis, the other at a much greater angle; subtriangular, the upper side arched and sometimes slightly grooved, lateral angles acute, inferior angle obtuse or rounded; scars uniform in size, 18 millimeters wide and 9 millimeters high; ramentum walls 4 to 5 millimeters thick, commissure distinct, the whole punctured with minute rhombic, triangular, or elliptical bract scars, deeply penetrating the structures; leaf bases usually wanting, but sometimes nearly filling the cavities; vascular bundles few, arranged in a row near the upper side of the petiole and others scattered over other parts; petioles all reflexed or pointing downward at a strong angle; reproductive organs numerous, situated directly over the leaf scars, *i. e.*, axillary, elliptical in outline, 15 millimeters wide, 10 millimeters high, the center occupied by the remains of the essential organs or by a circular cavity where these have disappeared; bract scars small and numerous, somewhat curved and arranged concentrically around the spadix, also passing out into the ramentum walls; armor 3 to 5 centimeters thick; woody zone 15 to 35 millimeters thick, divided into two or three rings; medulla about 5 centimeters in diameter, cylindrical or elliptical according to the shape of the trunk, heterogeneous in composition, being traversed by dike-like plates of a hard substance dividing it into chambers, often wanting, leaving a hollow center to the trunk.

Only two specimens are referable to this species, both of which agree almost exactly and show the distinct specific characters which so clearly separate it from all the others. The most perfect of these specimens was kindly sent me by Professor Uhler for comparison with the one in Mr. Bibbins' collection, which bears the number 1429 of the Museum of the Woman's College. This latter is a fragment freshly broken from a larger piece, which has not yet been recovered, although considerable is known of its history. It must have been taller than the perfect trunk and perhaps more cylindrical in shape. The other and almost complete conical trunk also has a history which I have not as yet sufficient data to record, but this much seems clear, that both these specimens were originally found at nearly the same spot.

No one has taken greater interest in the fossil cycads of Maryland than Professor P. R. Uhler, so long president of the Maryland Academy of Sciences and now Provost of the Peabody Institute of Baltimore, and it is fitting that this species should bear his name.

***Cycadeoidea Bibbinsi* n. sp.**

Trunks large, 40 to 60 centimeters high, laterally compressed, girth of largest specimen 1 meter, of next in size 88 centimeters, shorter axis of cross section one half to two thirds of longer axis, contracted toward the summit, terminating in a conical bud 30 centimeters high, or, where this is wanting, in a concave depression, thoroughly silicified throughout, heavy and solid, of a dark color; all the organs of the armor nearly at right angles to the axis of the trunk; leaf scars arranged spirally around the trunk in imperfect quincuncial order, subrhombic,

the lower angle much sharper than the upper, the latter sometimes reduced to a curve, 14 millimeters high, 26 millimeters wide; ramentum walls moderately thick, usually solid; vascular bundles of the petioles arranged in a row entirely around them and near the margin of a cross section, also sometimes a few near the center; spadices abundant, irregularly scattered over all parts of the surface, usually showing the marks left by the essential floral organs or a central cavity occupying their place, surrounded by curved or crescent-shaped pits concentrically arranged in several rows and set concave to the axis of the spadix, representing the involueral bracts; armor varying from 25 to 75 millimeters in thickness, this variation often great in different parts of the same specimen; cambium layer indistinct; liber zone not generally distinguishable from the wood; the latter in two or three zones, medullary rays faint; medulla well marked, homogeneous, usually spongy in appearance.

This species represents a type quite distinct from all the others, and the cycadean trunks of the Iron Ore deposits of Maryland might be divided into two classes, one of which should embrace all the forms included in the six species above described and the other those that have been referred to this species. The fact that the rock in the latter is always firm, hard, and heavy and usually dark colored is not merely an accident of preservation, but results in some obscure way from the nature of the vegetable tissues. The trunks are generally larger and the leaf scars much larger, though they have nearly the same form and arrangement. The reproductive organs are more abundant and usually very regular and definite in their character.

Eighteen specimens belong to this group, all but one of which are of Mr. Bibbins' collecting. The one exception is the fragment in the Museum of Johns Hopkins University that Professor Fontaine described as "Fragment No. 1," which I call No. 4. The most typical specimen is the great "Polly Jones Trunk," No. 1427 of the Museum of the Woman's College of Baltimore. The other sixteen in their numerical order are as follows: 1426, 1462, 1463, 1464, 1465, 1466, 1468, 1478, 1480, 1482, 1483, 1484, 1487, 3047, 3054, 3348. Of these, Nos. 1462, 1463, 1465, 1468, and 1482 are large, nearly perfect trunks, and Nos. 1463, 1468, and 1482 have the terminal bud preserved. The rest are fragments, but many of them are quite full and show important characters on the fractured surfaces that do not appear in the more complete specimens. No. 1483 has been cut through and the surfaces polished, and admirably shows the internal arrangements of the leaves, fruiting organs, and vascular strands supplying them. Nos. 1484 and 3054 give the maximum development of the leading characters, especially those of the fruiting organs.

In many respects this species represents the most important and interesting group of Maryland cycads, nearly all the specimens of which, as we have seen, having been secured by Mr. Bibbins, and I have therefore sought in causing the species to bear his name to make that name forever inseparable from the class of objects which he has done more than all others combined to bring out of their hiding places into the light of scientific investigation.

The above arrangement of the seven species of *Cycadeoidea* from the Iron Ore beds of Maryland is intended to be that of their affinities, as indicated by the characters described, taking the original *C. Marylandica* as the point of departure and concluding with the *C. Bibbinsi*, which exhibits the widest divergence from that norm. *C. Tysoniana*, *C. McGeana*, and *C. Fontaineana* represent a somewhat gradual transition. *C. Goucheriana* and *C. Uhleri* represent abrupt divergences in different directions, while *C. Bibbinsi*, as already stated, constitutes a distinct group.